

3. *Thamnophis sauritus proxima* (Say). Western Ribbon Snake. One specimen, 500 mm. in length was obtained on April 3, 1916, near the head of North Spring river.

4. *Chrysemys bellii* (Gray). Bell's Painted Turtle. Two specimens were caught in a drag seine at the head of North Spring river. Several other turtles, evidently belonging to this species, were seen in the lake-like enlargement of North Spring river, near Roswell.

MAX M. ELLIS,
Boulder, Colorado.

THE BREEDING HABITS OF *AMBYSTOMA OPACUM* (GRAVENHORST).

The first account of the breeding habits of the marbled salamander is a letter from the Rev. Charles Mann to S. F. Baird, in which he states that at Gloucester Court House, Va., they are found with eggs in the "beds of small ponds in the woods," from the summer to December, in which month he found one in a nest with 108 eggs. Apparently some of the eggs were broken, as he speaks of newly hatched young. This letter appears in the Report of the Smithsonian Institution for 1854, pp. 294-5.

In 1886, in the first Bulletin of the American Museum of Natural History, Col. Nicholas Pike gives an account of the breeding habits on Long Island. He accuses Mann of misidentification, (Mann's specimens are still in the U. S. N. M. and are *opacum*), and claims that *A. opacum* breeds in the spring, laying eggs in the water as does *A. maculatum*. He got larvae $\frac{1}{2}$ inch long in March. A mass of eggs hatched 15 days after taking, and transformed about July 29, at a length of $2\frac{1}{2}$ inches. He also got some May larvae $3\frac{1}{4}$ inches long.

In the light of the many following observations, all of which support Mann, there is little doubt but that Pike was in some error. The May larvae were

probably *opacum*, but the March larvae and the eggs were probably not. Pike contrasts the egg-mass with that of *A. maculatum*, but not with that of *A. tigrinum*, and possibly he had eggs of that species as it is known to breed on Long Island, and lays its eggs in the water in spring.

Brimley, in the *American Naturalist* for 1896, p. 500, says that at Raleigh, N. C., *A. opacum* lays eggs in October and November, on the edges of dry pools, where the larvae hatch quickly when the pool fills with water.

McAtee, in the Proceedings of the Biological Society of Washington, vol. 20, 1907, p. 13, describes the breeding habits in Monroe Co., Indiana. He speaks of "nests in the ground near the surface," which "contain from 50 to more than 150 eggs." The larvae may reach a length of an inch while in the egg, but they must have water to live in while completing their development. They transform in February and March.

In COPEIA 8, July, 1914, Engelhardt says he found larvae in June at Lakewood, N. J., in a locality in which adults had been caught; these larvae were one to one and a half inches long.

In COPEIA 28, March, 1916, Deckert speaks of getting eggs with the adult on September 25, near White Plains, N. Y., in the bed of a dried-up pool; the eggs were separate from each other and covered with dirt. They were kept in the debris for a day, and on September 27, some were put into water. These hatched on September 28; the larvae were $\frac{5}{8}$ inch long and front limbs were apparent. Other eggs were kept in the deep debris until October 18, put in water and hatched on October 19.

Larvae, 2 inches long, were collected in April, which transformed in June.

Brimley (Bull. Elisha Mitchell Sci. Soc., vol. 32, no. 2, July, 1916), says that at Raleigh, N. C., the habits of *A. opacum* differ from those of *A. maculatum* in that the eggs are not in gelatinous masses,

but separate from each other, and are laid not in the water in spring, but under dead logs in the beds of dried-up pools in October. The transformation takes place about May, the larvae reaching a length of at least $2\frac{1}{2}$ inches.

Engelhardt, in COPEIA 37, November, 1916, referring to Long Island (where Pike worked), states that he got larvae $1\frac{1}{8}$ to $1\frac{1}{4}$ inches long on April 7. He argues that these could not have come from eggs laid that spring as the pools were ice covered until April. The hind legs of these larvae appeared on April 18. Other larvae collected in May measured $2\frac{1}{2}$ inches in length.

Finally on September 20, 1916, near Mt. Vernon, Va., I got 7 adults, male and female, under one log. The females were larger than the males, and had a pronounced tendency for the cross-bands to break up into 2 longitudinal stripes (the same tendency has been noticed in females of *opacum* from elsewhere). The males had the lips of the cloaca everted and swollen.

Some of the females laid eggs in the collecting bucket. The next day I got several others near there, including a female in her nest with over 100 eggs. The eggs were entirely unconnected and were rather dusty. I kept the eggs from the several females in damp debris. Developments proceeded somewhat slowly until on October 2, they were put into 3 crystallizing dishes containing, (1) sand; (2) sand and water, the eggs being placed out of water; (3) water.

Those in the water began to hatch on October 15. When born they had fore-limb buds and balancers. Those eggs kept in dry sand until October 15, and put in water on that date hatched in 24 hours.

Eggs kept until November in sand saturated with water, did not hatch, but when put into water, hatched in 24 hours. Thus the entire egg must be surrounded with water for it to hatch. There is apparent here a very delicate adjustment to Coastal Plain conditions of flood and drouth.

Conclusions: It seems apparent from observations covering nearly the entire range of the animal, that *Ambystoma opacum* breeds in the fall. Fertilization is internal, takes place on land, and there is presumably a copulation. The eggs are separate from each other, and are laid in hollows in the ground excavated by the mother, who remains with the eggs, lying on top of them. The nests are in places such that they will be flooded during the winter. The eggs can stand a long desiccation and such eggs hatch almost immediately upon being put into water. The new born larvae have balancers and forelimbs. The larvae transform in the following spring at a length of about 3 inches.

EMMETT R. DUNN,
Northampton, Mass.

DIADOPHIS AMABILIS IN MISSOURI.

Cope recognized four forms of *Diadophis amabilis* distinguished by coloration. The specimen under consideration conformed in every way to the variety *Diadophis amabilis amabilis*. Cope listed his specimens of this variety as collected in California and Louisiana, while he gave the probable distribution of the species as Pacific, Central or Sonoran.

Ditmars recognizes only one variety, *pulchellus*, which inhabits Oregon and California. He gives the distribution of *Diadophis amabilis* as Texas westward to the Pacific, northward to Washington, and Sonora, Mexico.

It is interesting then that this species was found in Macon, Missouri, October 4, 1916, coiled near the roots of some matted grass. It measured 24 centimeters in length and had the vivid coloration of a young snake. The scales were arranged in 15 rows and superior labials numbered 7. The dark spots on the orange of the ventral surface were irregularly